a good diffractogram. In
other minerals that are
lspar (belonging to the
:face of concrete).

›scope, the neo-formation
ntration were located for
›n purity. The reaction
iffractometer, Geigerflex
Kv, 20 mA. Additionally,
in order to determine the

ered by alkali-aggregate
›ncentration of material
e highly fissured. The
th a mineral that was
tical properties (low
fractive indices, between
tive clasts, are randomly
perpendicularly to the
the quartz clasts with
N° 3).

rograph N° 4: an external
d, and an internal zone,

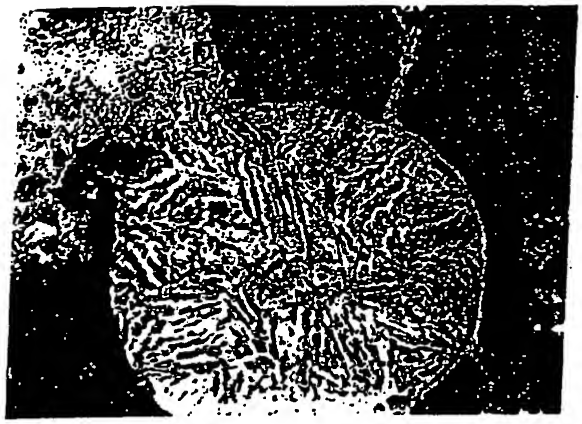
.e, by picking under the
the ten available thin
›n a glass slide. Table I
.e quartz ones, those

.tructural formula similar
›stem. The corresponding

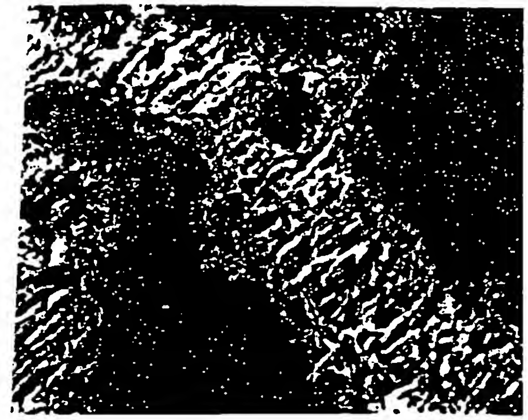
: N° 5 and N° 6) where the
.nic system, can be seen.

.imits for zeolite by XRD,
;, 5 %, and 10 % of a
:te was used in this case,
N° II). The results with
in Table N° II and figure

:ge reflection (8.95 A, 2θ
:responds to quartz and
lections, besides those of
B3), zeolite is clearly
:ed under the microscope
inoptilolite to a concrete
e taken into account.

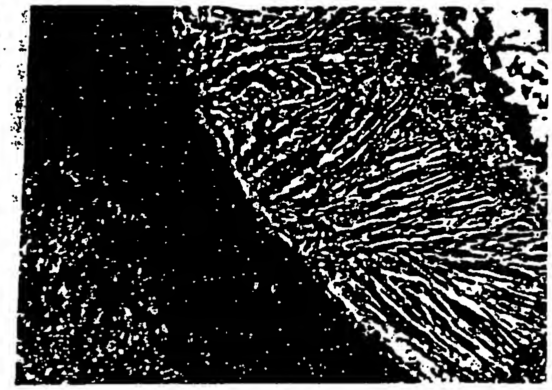


PHOTOMICROGRAPH N° 1



PHOTOMICROGRAPH N° 2

PHOTOMICROGRAPH N° 3



PHOTOMICROGRAPH N° 4

PHOTOMICROGRAPH N° 5

PHOTOMICROGRAPH N° 6

TABLE I

Clinoptilolite JCPDS 39 - 1383			Zeolite concrete *	
d A	I/I_0	hkl	d A	I/I_1
8.95	100	020	9.03	29
7.93	13	200	-	-
6.78	9	201	6.78	9
5.24	10	311	-	-
5.12	12	111	5.14	12
4.65	19	131	4.66	13
4.35	5	401	4.262	30 Q
3.976	61	131	-	-
3.955	63	400	3.959	19
3.905	48	240	3.910	17
3.554	9	312	3.570	16
3.424	18	222	-	-
3.392	12	402	3.343	100 Q
3.170	16	422	-	-
3.120	15	441	-	-
2.998	18	351	-	-
2.971	47	151	2.976	15
2.795	16	530	2.794	12
2.730	16	530	-	-
2.458	3	641	2.450	11 Q
-	-	-	1.982	10 Q
-	-	-	1.820	12 Q

* Isolated by picking under the microscope
Q = Quartz

Conclusions

1. The product of alkali-aggregate reaction of the studied concrete corresponds to a zeolite of the heulandite group: clinoptilolite.

2. The XRD method allows a clear identification of the reaction products, provided a high degree of purity is achieved when isolated from concrete, although the use of the petrographic microscope furnishes excellent results.

3. Isolation by using thin sections is the safer concentration method, the material being contaminated only by the minerals of the aggregate. For the identification of the zeolite, 10 mg of sample proves to be enough.

4. The minimum percentage detectable by XRD for the reaction products studied is approximately 5 %.

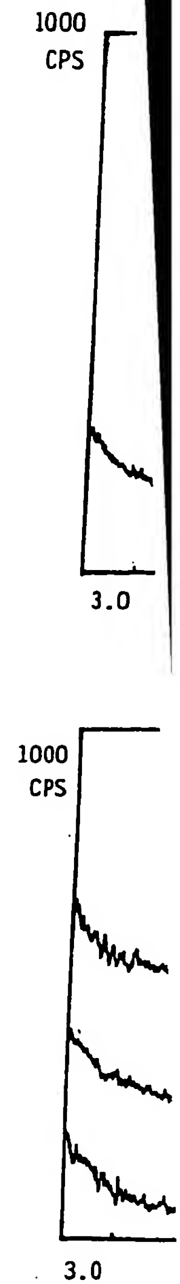


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FIGURE A

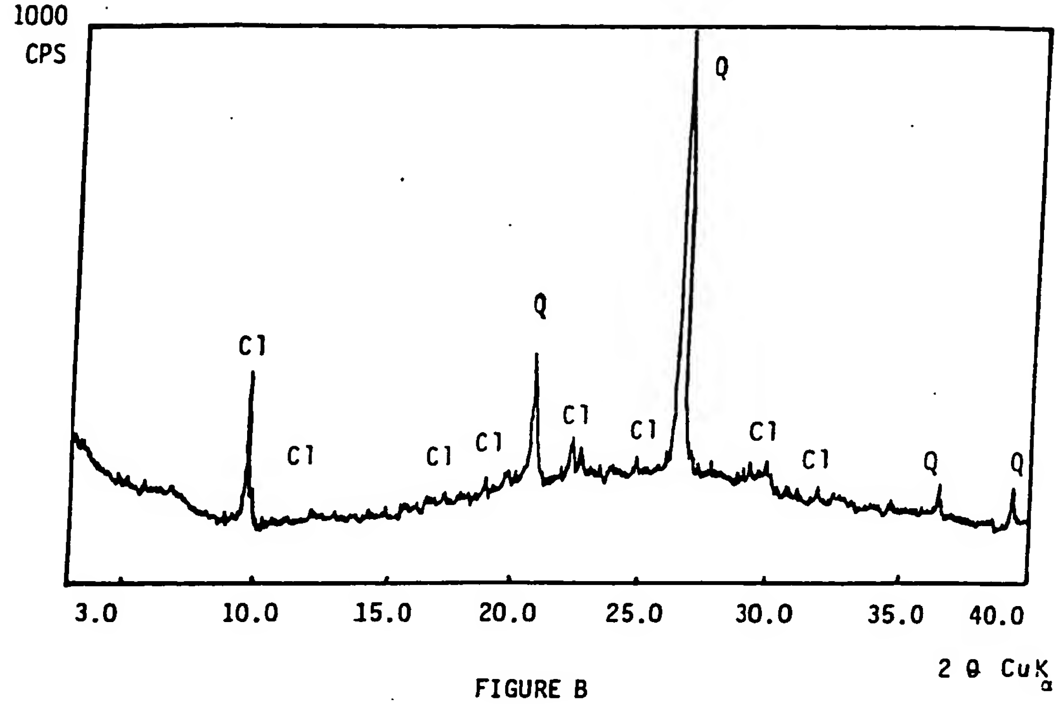

FIGURE B

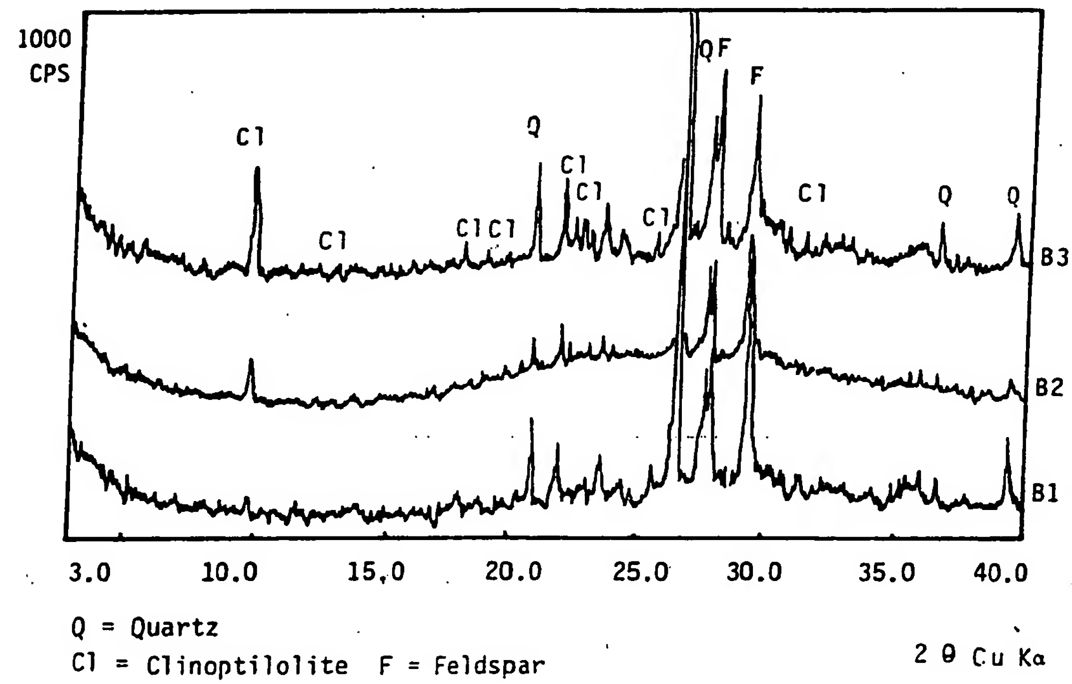

TABLE II

Concrete with the addition of 1 % of zeolite		Concrete with the addition of 5 % of zeolite		Concrete with the addition of 10 % of zeolite		Natural zeolite (Clinoptilolite)	
d A	I/I_1	d A	I/I_1	d A	I/I_1	d A	I/I_1
8.95	11	9.02	18	8.98	23	8.97	100
-	-	-	-	6.77	9	6.80	6
5.24	9	-	-	-	-	5.25	6
-	-	-	-	5.13	10	5.12	9
-	-	4.67	10	-	-	4.66	12
4.26Q	23	4.267Q	21	4.263Q	23	4.358	5
-	-	4.04	15	3.975	14	3.989	27
3.854	14	3.859	13	3.899	15	3.959	24
-	-	-	-	3.860	13	3.912	20
-	-	-	-	3.567	11	3.556	7
-	-	3.477	12	3.517	11	3.427	15
3.346Q	100	3.350Q	100	3.347Q	100	3.395	10
-	-	3.323F	15	3.311F	14	-	-
-	-	3.187F	37	3.189F	37	3.174	12
3.122	14	3.127	13	3.126	14	3.125	9
3.086	14	3.067	15	3.042	30	-	-
-	-	-	-	3.006	18	2.997	14
-	-	-	-	2.968	15	2.979	20
-	-	2.779	12	2.788	13	2.801	13
-	-	2.730	12	2.731	13	2.734	8
2.456	13	2.460	15	2.458	15	2.448	5
-	-	2.099	12	-	-	-	-

F = Feldspar

References

1. S. A. Marfil and P.J. Maiza. Mineralogía de los productos formados en hormigones deteriorados por la reacción álcali-agregado. Primer Congreso Uruguayo de Geologia. Tomo I Pp. 149-153. Montevideo. Uruguay.

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ABSTRACT

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